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ORIGINAL PAPER

A Shorter and Multidimensional Version of the Gambling Attitudes and Beliefs Survey (GABS-23)

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Abstract The Gambling Attitudes and Beliefs Survey (GABS) is a questionnaire which explores gambling-related dysfunctional beliefs in an unidimensional way. The present research aims to investigate the dimensionality of the scale. 343 undergraduate student gamblers and 75 pathological gamblers seeking treatment completed the GABS and the south oaks gambling screen. Exploratory and confirmatory factor analyses revealed that the original one-factor structure of the GABS did not fit the data effectively. We then proposed a shorter version of the GABS (GABS-23) with a new five-factor structure, which fitted with the data more efficiently. The comparisons between students (problem vs. non-problem gamblers) and pathological gamblers seeking treatment indicated that the GABS-23 can discriminate between problem and non-problem gamblers as efficiently as the original GABS. To ensure the validity and the stability of the new structure of the GABS-23, analyses were replicated in an independent sample that consisted of 628 gamblers (256

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non problem gamblers, 169 problem gamblers who are not treatment-seeking and 203 problem gamblers seeking treatment). Analyses showed satisfactory results, and the multidimensional structure of the GABS-23 was then confirmed. The GABS-23 seems to be a valid and useful assessment tool for screening gambling-related beliefs, emotions and attitudes among problem and non-problem gamblers. Moreover, it presents the advantage of being shorter than the original GABS, and of screening irrational beliefs and attitudes about gambling in a multidimensional way. The five-factor model of the GABS-23 is discussed based on the theory of locus of control.

Keywords Pathological gambling · Cognitions · Assessment · Scale validation · Locus of control

Introduction

Pathological gambling (PG) is an impulse-control disorder characterized by uncontrollable gambling that causes serious damages to social, family, or financial life. The prevalence of PG is estimated about 0.2–3.0 % (Ladouceur et al. 2005; Petry et al. 2005).

Cognitive-behavioral therapies (CBT) have occupied a prominent position in the treatment of PG over the last decade. They have demonstrated their efficacy (Breen et al. 2001; Lopez Viets and Miller 1997; Petry et al. 2006; Petry and Armentano 1999; Sharpe 2002; Tavares et al. 2003; Toneatto and Ladouceur 2003; Toneatto and Millar 2004), and focus on gambling-related beliefs, behaviors and emotions, which are thought to contribute to the onset and maintenance of gambling problems (Toneatto and Millar 2004).

Gambling-related beliefs consist mainly in wrongly attributing outcomes to a causal relationship between two independent events that actually depend on chance (Joukhador et al. 2004; Ladouceur and Walker 1996; Toneatto et al. 1997; Walker 1992). Irrational beliefs can be categorized according to the opposition between skill and luck. Problem gamblers often attribute losses to bad luck and wins to personal skill, and end up acquiring the conviction that there are gambling strategies that can increase their chances of winning. Beliefs based on skill are associated with the concept of illusion of control, which is the perceived ability to predict or control gambling outcomes via personal skill or knowledge (Delfabbro 2004; Gaboury and Ladouceur 1989; Langer 1975; Langer and Roth 1975). At the opposite end of the spectrum, beliefs based on luck refer to a common belief in "good or bad luck". This dimension includes superstitions or rituals like carrying a lucky charm, avoiding or seeking out a specific person because they are supposed to bring bad or good luck (Toneatto 1999).

Gambling-related behaviors result from two beliefs about attitudes to adopt when gambling (Toneatto 1999). The first example of irrational behavior concerns some "good" attitudes which are supposed to increase the probability of winning. This includes being very careful to act calm whatever the situation may be (losing or winning), or feeling confident during the game. The second example of irrational behavior is chasing, i.e. continued gambling, despite losses, in the irrational belief of 'getting even'. Chasing behavior has always been defined as returning to gamble on another day to 'get even' and chase losses. Breen and Zuckerman (1999) introduced the concept of "within-session" chasing behavior, that is persistent gambling when losing or winning within a particular session of gambling.

Gambling-related emotions are based on the theory of sensation-seeking developed by Zuckerman. Sensation seeking is defined as a tendency to seek intense stimulations in order

to balance a lack of emotional reactivity with common stimulations. The arousal (level of emotional excitement) produced when gambling allows the gambler to reach and maintain the desired high level of emotional stimulation (Zuckerman 1971, 1994).

Having a tool to assess the strength of attitudes, beliefs and emotions specific to gambling is a necessary preliminary step towards any research on gambling-related cognitions or on the efficacy of CBT in PG. In 1999, Breen and Zuckerman developed the Gambling Attitudes and Beliefs Survey (GABS), which measures cognitive biases, irrational beliefs, and positively valued attitudes to gambling (Breen and Zuckerman 1999). GABS scores can discriminate problem gamblers from non-problem gamblers. Gamblers with higher GABS scores fail to see gambling as a social and exciting leisure activity, and place great emphasis on luck and illusory strategies, which are common traits among problem gamblers. In their original study, Breen and Zuckerman did not detail the factor analyses, saying only that they were surprised to find that only one factor emerged. Even if a global assessment of these dysfunctional cognitions is helpful, a multidimensional approach may allow researchers, clinicians and others to focus on the specific beliefs or attitudes that are problematic for a specific person or a specific game.

We conducted two studies on the GABS. The aim of the first study was to carry out factor analyses to define the best-fitted structure of the GABS. We actually aimed to propose a multidimensional structure of the GABS, and to explore its psychometric properties and its validity. In order to ensure the stability of the new structure of the GABS, we conducted a second study where analyses were replicated in an independent sample. We also seized the opportunity to validate a French version of the GABS, for a use in French-speaking countries.

Study 1

Method

Participants

The participants were 579 University students from four faculties (Pharmacy, Medicine, Psychology and Sciences) and 75 pathological gamblers seeking treatment. Participation in the study was proposed to the students either orally by one of the authors during a course, or by disseminating an online survey via an email from the teaching team. For pathological gamblers seeking treatment, participation in the study was included in a systematic evaluation procedure available to all patients starting treatment in the service for a gambling problem. Following Breen and Zuckerman's instructions (Breen and Zuckerman 1999), only participants who reported gambling on at least one occasion in the previous year were retained for analyses ($N = 418$, 72.2 %). The students were mainly women ($N = 224$, 65.7 %), and their mean age was 21.1 years ($SD = 3.2$). At the opposite, the pathological gamblers seeking treatment were mainly males ($N = 61$, 81.3 %), and their mean age was 42.0 years ($SD = 12.4$). Globally, the whole sample were mainly women (56.9 %), and their ages ranged from 18 to 67 years ($M = 24.9$, $SD = 10.0$).

Participants were informed about the research and gave orally their informed consent prior to their inclusion in the study. French legislation about biomedical research did not require any ethical board approval for this study. However, this research was approved by a local scientific committee of independent experts which had reviewed and approved the

protocol, including an ethical evaluation. All authors of the present paper state that they have complied with the ethical standards of the Declaration of Helsinki.

Measures

The whole questionnaire included a few questions about gender, age, and participation in gambling over the previous year, as well as the two scales (SOGS and GABS).

South Oaks Gambling Scale (SOGS) (Lesieur and Blume 1987) The SOGS is a 20-item self-report questionnaire used to assess the severity of gambling problems (Lesieur and Blume 1987; Stinchfield 2002; Strong et al. 2004; Wulfert et al. 2005). South oaks gambling scale scores enable to distinguish between probable pathological gamblers (5 or higher), problem gamblers (3 or 4) and non-problem gamblers (2 or lower). In order to stay close to Breen and Zuckerman's work, we chose to use the 'problem' threshold to define the problem student gamblers category (3 or higher). Moreover, this threshold allowed us to include both gamblers "at risk" for PG and gamblers with a diagnostic of PG. We indeed wanted to include problem gamblers ever since they presented abuse of gambling (harmful use) and not only when they showed a confirmed diagnosis of dependency to gambling. This threshold has already been used earlier in literature, especially for the famous prevalence survey about problem gambling performed in Quebec in 2002 (Ladouceur et al. 2005). Within the student sample, 3.8 % were identified as problem gamblers ($N = 13$). All the pathological gamblers seeking treatment were in the pathological range of the SOGS, and met the diagnostic criteria of PG according to the DSM.

Gambling Attitudes and Beliefs Survey (GABS) (Breen and Zuckerman 1999) The GABS is a 35-item self-report questionnaire which assesses irrational beliefs and attitudes about gambling (Breen and Zuckerman 1999). Participants are asked to use a four-point Likert scale (from 'strongly agree' to 'strongly disagree') to indicate the extent to which they agree with each item. The French version of the GABS consisted of the 35 items proposed by Breen and Zuckerman translated into French. In order to confirm this translation, a professional translated it back into English. For even greater validity, two bilingual psychiatrist/psychologist, who are experts in gambling, proofread the French version. They suggested some adjustments and introducing a definition of what a gambling game is (as the French language does not have a specific word for 'gambling'). A copy of the French version of the GABS is included in section "Appendix 1".

Statistical Analysis

Confirmatory factor analysis (CFA) (Schumacker and Lomax 2004) was first performed on the one-factor structure of the GABS. The goodness of fit was tested with the χ^2 (a non significant value corresponds to an acceptable fit). However, it is not unusual to obtain significant χ^2 when performing CFA on large sample sizes or on self-report questionnaires (Byrne 1994; Marsh et al. 1988). So other fit indexes were used (Gadelrab 2010; Hu and Bentler 1999), with the following criteria used to indicate goodness of fit:

- Root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR): <0.06 for a good fit
- Comparative fit index (CFI) and incremential fit index (IFI): >0.97 for an acceptable fit
- Non normed fit index (NNFI): >0.93 for an acceptable fit

If all of these fit indices were found to be at least acceptable, then the original one-factor structure would be considered to be well fitted to the data. If that was not the case, new multi-factorial structures would be proposed, based on exploratory factor analysis (EFA) and clinical expertise, and then tested by a new CFA. Finally, the structure with the best fit and correct fit indices to the data was selected (structural validity).

Cronbach's alpha coefficient (α), which measures internal consistency (Cronbach 1951), and Loevinger's H coefficient (H), which measures scalability (Sijtsma and Molenaar 2002), were computed. An $\alpha > 0.7$ was considered a acceptable value (Fayers and Machin 2007) and $H > 0.3$ a correct scalability, and $H > 0.5$ a strong scalability.

The known-groups validity of the scale (Fayers and Machin 2007) was evaluated based on the comparison of non-problem student gamblers, problem student gamblers and pathological gamblers seeking treatment. ANOVA were performed to test for differences in mean GABS scores across these 3 categories.

In order to investigate the construct validity of the scale, a multitrait analysis (Fayers and Machin 2007) was performed by computation of the correlation coefficients between the score of each item and the one of each dimension (or the rest-score for the dimension of the item).

The multitrait-multimethod convergent and divergent validities were then evaluated by computation of correlation coefficients between subscale scores and the overall score of the GABS on the one hand (multimethod divergent validity), and between GABS and SOGS scores on the other hand (multimethod convergent validity) (Fayers and Machin 2007). The magnitude of correlation that will show evidence is >0.4 for convergent validity, and <0.3 for divergent validity.

Finally, mean scores of the GABS were compared by gender using an ANOVA.

All the statistical analyses were performed using STATA 11 and LISREL 8.80, with the conventional 5 % value for statistical significance.

Results

Factor Analysis

CFA showed that the one-factor model of the GABS not fit the data (see Table 1). Combining both EFA results and clinical expertise, we therefore put forward a new structure—the SCALE structure—, composed of 23 items (GABS-23), distributed across five dimensions (see section "Appendix 2" for the english-version and the scoring of the GABS-23):

- Strategies (GABS-S): 19, 23, 28, 32 (conviction in illusory gambling strategies supposed to increase the probability of winning)
- Chasing (GABS-C): 2, 14, 25, 31, 33 (concept of "within-session chasing": persistent gambling when losing or winning within a particular session of gambling)
- Attitudes (GABS-A): 7, 10, 21, 30, 34 (conviction in gambling attitudes thought to increase the probability of winning)
- Luck (GABS-L): 8, 12, 20, 29 (belief in good or bad luck and in superstitions)
- Emotions (GABS-E): 1, 18, 26, 27, 35 (subjective arousal (emotional excitement) provided by gambling)

Table 1 shows the results of the CFA performed on the one-factor and the SCALE multidimensional models of the GABS. As anticipated, the χ^2 for each tested model presented a significant value, which theoretically corresponds to a non acceptable fit.

Table 1 Confirmatory factor analysis

	Study 1[a]		Study 2[b]	
	GABS-35 French version of the original one-factor structure of the GABS	GABS-23 Revised-structure of the GABS, in 23 items and 5 dimensions	GABS-35 French version of the original one-factor structure of the GABS	GABS-23 Revised-structure of the GABS, in 23 items and 5 dimensions
χ^2 (*P* value) (non significant)	1998.11-560DF ($P < 0.0001$)	421.60-220DF ($P < 0.0001$)	2878.91-560DF ($P < 0.0001$)	604.90-220DF ($P < 0.0001$)
RMSEA [≤0.06]	0.094	**0.047**	0.083	**0.054**
SRMR [≤0.06]	0.073	**0.046**	0.065	**0.049**
CFI [≥0.97]	0.93	**0.98**	0.92	**0.97**
IFI [≥0.97]	0.93	**0.98**	0.92	**0.97**
NNFI [≥0.93]	0.92	**0.98**	0.91	**0.96**

Norms to consider a good or acceptable fit are indicated between square brackets. Indices which fitted with these norms are indicated in bold

For the χ^2, a non significant value theoretically corresponds to an acceptable fit. However, it is not unusual to obtain significant χ^2 when performing CFA on large sample sizes or on self-report questionnaires

RMSEA root mean square error of approximation, *SRMR* standardized root mean square residual, *CFI* comparative fit index, *IFI* incremential fit index, *NNFI* non normed fit index

[a] Sample of 343 undergraduate student gamblers and 75 pathological gamblers seeking treatment

[b] Sample of 628 gamblers (256 non problem gamblers, 169 problem gamblers who are not treatment-seeking and 203 pathological gamblers seeking treatment)

However, as mentioned in the method section, it is usual to obtain significant χ^2 when performing CFA on large sample sizes or on self-report questionnaires, as it is the case here. With this in mind and because each of the other fit indices of the GABS-23 were good, the goodness of fit of the GABS-23 was considered acceptable.

Psychometric Properties of the GABS-23

Computation of the Scores The raw scores of each dimension had been standardized on a scale ranged from 0 to 100, in order to allow comparison between the scores of each dimension. To obtain the standardized score of a subscale, the raw subscale score was divided by three times the number of items of the subscale, and the result was then multiplied by 100. An overall score of the GABS-23 had then been computed as the unweighted mean of the five standardized dimensional scores (see section "Appendix 2" for further explanation of the scoring).

Internal Consistency and Scalability of the GABS-23 Internal consistency and scalability of the SCALE structure of the GABS-23 were compared with those of the original one-factor structure of the GABS-35 (see Table 2). Internal consistencies for each dimension of the GABS-23 were acceptable ($\alpha \geq 0.70$), except for "strategies" (GABS-S), which was just under 0.70. The scalabilities of each dimension were at least correct ($H > 0.3$), with a majority displaying strong scalability ($H > 0.5$).

Table 2 Internal consistency and scalability: Cronbach's α and Loevinger's H coefficients

		Study 1[a]		Study 2[b]	
		Cronbach's α (>0.70)	Loevinger's H (>0.30)	Cronbach's α (>0.70)	Loevinger's H (>0.30)
GABS-23	Chasing (GABS-C)	**0.84**	**0.56**	**0.80**	**0.49**
	Emotions (GABS-E)	**0.83**	**0.56**	**0.75**	**0.42**
	Attitudes (GABS-A)	**0.72**	**0.38**	0.67	**0.32**
	Luck (GABS-L)	**0.76**	**0.54**	0.65	**0.39**
	Strategies (GABS-S)	0.69	**0.40**	0.68	**0.38**
	Overall score	**0.93**	**0.33**	**0.89**	0.28
French version of the GABS-35	Overall score	**0.93**	**0.31**	**0.88**	0.21
Original GABS-35 (Breen and Zuckerman 1999)	Overall score	**0.93**	Unknown		

Norms to consider acceptable internal consistency and correct scalability are indicated between square brackets. Coefficients which fitted with these norms are indicated in bold

GABS-35 = original version of the GABS with 35 items, GABS-23 = revised version of the GABS with 23 items and a multidimensional structure. "Strategies" (GABS-S) refers to the conviction in illusory gambling strategies supposed to increase the probability of winning, "Luck" (GABS-L) refers to the belief in good or bad luck and in superstitions, "Chasing" (GABS-C) refers to the concept of "within-session chasing" (i.e., persistent gambling when losing or winning within a particular session of gambling), "Attitudes" (GABS-A) refers to the conviction in gambling attitudes thought to increase the probability of winning, and "Emotions" (GABS-E) refers to the subjective arousal (emotional excitement) provided by gambling

[a] Sample of 343 undergraduate student gamblers and 75 pathological gamblers seeking treatment

[b] Sample of 628 gamblers (256 non problem gamblers, 169 problem gamblers who are not treatment-seeking and 203 pathological gamblers seeking treatment)

Known-Groups Validity of the GABS-23 Table 3 shows comparisons between non-problem student gamblers, problem student gamblers, and pathological gamblers seeking treatment. In the same way as in the original GABS (Breen and Zuckerman 1999), the overall score of the GABS-23 was found to discriminate significantly between non-problematic and problematic student gamblers, but not between problematic student gamblers and pathological gamblers seeking treatment. The same pattern of results was found for each dimension of the GABS-23, except for "chasing" and "emotions", where pathological gamblers seeking treatment scored significantly higher than problematic student gamblers.

Construct Validity of the GABS-23 Results of the multitrait analysis allowed us to detect only two items (14 and 28) that were more correlated with the score of another dimension than the score of their own dimension: item 14 is more correlated with the "emotions" dimension ($R = 0.611 > R = 0.565$ with its own dimension "chasing"), and item 28 is more correlated with the "attitudes" dimension ($R = 0.532 > R = 0.482$ with its own

Table 3 Known-groups validity in study 1: means (*and standard deviations*) of the GABS scores for non-problem students gamblers, problem students gamblers and pathological gamblers seeking treatment

	GABS-23						French version of the GABS-35 (score 35–140)	Original GABS-35 (Breen and Zuckerman 1999) (score 35–140)
	Strategies GABS-S (score 0–100)	Luck GABS-L (score 0–100)	Attitudes GABS-A (score 0–100)	Chasing GABS-C (score 0–100)	Emotions GABS-E (score 0–100)	GABS-23 overall score (score 0–100)		
Non-problem students gamblers [SOGS < 3] ($n = 330$)	31.19 (24.48)	27.67 (20.95)	46.46 (22.50)	17.92 (15.06)	15.89 (14.90)	27.80 (13.56)	66.40 (13.63)	76.07 (14.89) [$n = 530$]
Problem students gamblers [SOGS ≥ 3] ($n = 13$)	51.28 (29.82)	44.87 (35.44)	61.03 (27.06)	38.97 (29.67)	43.59 (29.77)	47.95 (21.70)	88.46 (21.36)	92.11 (15.29) [$n = 95$]
Pathological gamblers seeking treatment ($n = 75$)	46.22 (20.93)	35.00 (25.11)	60.71 (18.19)	56.89 (20.69)	54.76 (22.44)	50.72 (15.13)	91.25 (14.23)	92.65 (13.15) [$n = 86$]
ANOVA *F(2,407DF)* *P* value	$F = 18.62$ **$P < 0.0001$**	$F = 6.46$ **$P = 0.0017$**	$F = 14.68$ **$P < 0.0001$**	$F = 167.37$ **$P < 0.0001$**	$F = 165.67$ **$P < 0.0001$**	$F = 87.47$ **$P < 0.0001$**	$F = 105.11$ **$P < 0.0001$**	***Significant***
ANOVA between the latter 2 groups *F(1,407DF)* *P* value	$F = 0.60$ $P = 0.438$	$F = 2.17$ $P = 0.141$	$F = 0.00$ $P = 0.962$	$F = 12.57$ **$P = 0.0004$**	$F = 4.72$ **$P = 0.0305$**	$F = 0.42$ $P = 0.516$	$F = 0.44$ $P = 0.508$	*Non significant*

Sample of 343 undergraduate student gamblers and 75 pathological gamblers seeking treatment. Significant differences (i.e., *P* value < 0.05) are indicated in bold

GABS-35 = original version of the GABS with 35 items, GABS-23 = revised version of the GABS with 23 items and a multidimensional structure, SOGS = South Oaks Gambling Screen. "Strategies" (GABS-S) refers to the conviction in illusory gambling strategies supposed to increase the probability of winning, "Luck" (GABS-L) refers to the belief in good or bad luck and in superstitions, "Chasing" (GABS-C) refers to the concept of "within-session chasing" (i.e., persistent gambling when losing or winning within a particular session of gambling), "Attitudes" (GABS-A) refers to the conviction in gambling attitudes thought to increase the probability of winning, and "Emotions" (GABS-E) refers to the subjective arousal (emotional excitement) provided by gambling

dimension "strategies"). Nevertheless, the correlation coefficients were not so different in the two cases.

Multitrait-Multimethod Convergent and Divergent Validities of the GABS-23 Results for the convergent and divergent validities are presented in Table 4. The correlation coefficient between GABS-23 overall score and SOGS score was around 0.60, showing a positive correlation between cognitive distortions and gambling problems. The five subscales scores exhibited two distinct patterns of correlation with SOGS score: correlation with "chasing" and "emotions" dimensions was strong, whereas correlations with "strategies", "luck" and "attitudes" dimensions were very weak. All the correlation coefficients between GABS-23 overall and subscale scores fell between 0.57 and 0.83 (and above 0.73 when excluding the "luck" dimension), showing positive links between the five dimensions. Using the overall score of the scale would therefore be acceptable. Nevertheless, the correlation coefficients were moderate. Consequently, it is preferable to maintaining a dimensional interpretation of the scale.

Table 4 Convergent and divergent validities in study 1: Pearson's correlation coefficients between scores of the former and proposed versions of the GABS and score of the SOGS

	GABS-23						French version of the GABS-35	SOGS
	Strategies GABS-S	Luck GABS-L	Attitudes GABS-A	Chasing GABS-C	Emotions GABS-E	Overall score		
GABS-23								
Strategies GABS-S	1.00							
Luck GABS-L	0.32	1.00						
Attitudes GABS-A	0.57	0.22	1.00					
Chasing GABS-C	0.49	0.39	0.43	1.00				
Emotions GABS-E	0.48	0.33	0.46	0.75	1.00			
Overall score	0.75	0.57	0.73	0.83	0.83	1.00		
French version of the GABS-35	0.73	0.54	0.70	0.83	0.83	0.98	1.00	
SOGS	0.28	0.19	0.25	0.70	0.70	0.59	0.61	1.00

Sample of 343 undergraduate student gamblers and 75 pathological gamblers seeking treatment

GABS-35 = original version of the GABS with 35 items, GABS-23 = revised version of the GABS with 23 items and a multidimensional structure, SOGS = South Oaks Gambling Screen. "Strategies" (GABS-S) refers to the conviction in illusory gambling strategies supposed to increase the probability of winning, "Luck" (GABS-L) refers to the belief in good or bad luck and in superstitions, "Chasing" (GABS-C) refers to the concept of "within-session chasing" (i.e., persistent gambling when losing or winning within a particular session of gambling), "Attitudes" (GABS-A) refers to the conviction in gambling attitudes thought to increase the probability of winning, and "Emotions" (GABS-E) refers to the subjective arousal (emotional excitement) provided by gambling

Gender Differences

Results of the gender comparisons showed that females in the sample scored significantly lower on the overall and dimensional scores of the GABS-23 (each of the p value were under 0.0001), with the exception of "luck" dimension where males and females had similar scores ($F = 1.26$, $p = 0.262$) (with an observed score that was higher for females, although not significantly).

Discussion of Study 1

The aim of study 1 was to investigate a multidimensional model of the GABS. The factor analyses indicated that a multidimensional model of the scale is better than an unidimensional model, thus confirming the Breen and Zuckerman's uncertainty regarding the one-factor structure of the original GABS (Breen and Zuckerman 1999). Combining statistical methods with a clinical approach allowed us to put forward a multifactorial and shorter version of the GABS, the GABS-23. The GABS-23 is composed of 23 items and can measure five distinct dimensions of attitudes, emotions and beliefs about gambling.

This study was conducted on a large sample of students and pathological gamblers seeking treatment, in order to fit the types of participants initially selected by Breen and Zuckerman (1999). This raises the question of the validity of the GABS in the general population, because the bulk of the sample was undergraduates, who are not representative of the general population. Moreover, the samples used are very disparate (college students versus pathological gamblers seeking treatment), and it is then difficult to justify comparisons. The number of problem gambling students was also too small from which to derive stable analyses. Finally, another weakness of the sample selection is that the sex distribution was not balanced within the two samples, with students who were predominantly females and pathological gamblers seeking treatment who were mainly males, which may introduce confusion biases.

Study 2

Study 1 showed some important limitations (first of all the disparity of the samples and the restricted number of problem student gamblers) which may call into question the validity of this new version of the questionnaire. Thus, analyses were replicated on an independent and more suitable sample to ensure the validity and stability of the new structure of the GABS.

Methods

Participants

The participants were 628 gamblers who took part in the *JEU* cohort study that is currently taking place (see the "Acknowledgments" section). The primary purpose of the *JEU* cohort is to explore the determinants of transitions in the gambling course, such as emergence of problem gambling, seeking of care, spontaneous resolution of problem gambling, relapse, etc. We seized the opportunity to have new data available with the cohort *JEU* to use them to confirm the factor structure of the GABS-23. The recruitment of the *JEU* cohort was done in gambling places (casinos, smoke shops with gambling

products, etc.) and by press. The sample was constituted of 256 non problem gamblers, 169 problem gamblers who are not treatment-seeking and 203 problem gamblers seeking treatment. Each participant reported gambling on at least one occasion in the previous year and was aged between 18 and 65 years old. The participants were mainly men ($N = 418$, 66.6 %), and the proportion of men increased in the three groups: non problem gamblers ($N = 142$, 55.5 %), problem gamblers not seeking treatment ($N = 111$, 65.7 %) and problem gamblers seeking treatment ($N = 165$, 81.3 %) ($F = 17.51$, $p < 0.0001$). The mean age of the whole sample was 43.4 years ($SD = 12.9$), and was different within the three groups: non problem gamblers ($M = 43.5$ years, $SD = 13.6$), problem gamblers not seeking treatment ($M = 46.1$ years, $SD = 13.1$) and problem gamblers seeking treatment ($M = 40.9$ years, $SD = 11.4$) ($F = 7.57$, $p = 0.0006$). The sex distribution, especially in the treatment seeking group, and the mean age of our sample were closer to the well-known data about gamblers in the general population (Martins et al. 2004; Ladouceur et al. 2005; Petry et al. 2005), which means that the present sample is more suitable to investigate the validity of the GABS than a student sample.

Participants were informed about the research and gave their written informed consent prior to their inclusion in the study. This study has been approved by the CPP (the French Research Ethics Committee) and has been performed in accordance with the ethical standards of the Declaration of Helsinki.

Measures

The parameters studied were the same as in study 1: gender, age, SOGS and GABS scores. In order to enhance the accuracy of the classification of problem versus non problem gamblers, the PG section of the DSM-IV (APA 2000) was also used in addition to the SOGS. Indeed, the SOGS scores often over-estimated the prevalence of gambling problems, especially in the general population (Stinchfield 2002). In the present sample, the Kappa between SOGS and DSM-IV classifications was 0.84 ($\chi^2 = 748.64$, $p < 0.0001$), with an estimation of the prevalence of gambling problems with the SOGS twice as higher than with the DSM-IV.

Pathological Gambling Section on the DSM-IV (APA 2000) Participants answered an interview based on the 10 diagnostic criteria for PG of the DSM-IV. Gamblers who met at least 3 DSM-IV criteria were classified as problem gamblers (including both gamblers "at risk" for PG and gamblers with a diagnostic of PG), and those remaining as non-problem gamblers. With the same logic as for the SOGS, we used a non-standard threshold of 3 instead of 5 to include subclinical forms of problem gambling. These subclinical forms could be considered as forms of abuse of gambling similarly to the notion of substance abuse (Potenza 2006). Previous literature supported the relevance of this categorization (Toce-Gerstein et al. 2003), which follows the current addictological logic of the future DSM-V (which is due to regroup abuse and dependency under the global concept of addiction).

Statistical Analysis

Statistical analyses of study 1 were replicated identically, except the EFA. The known-groups validity was evaluated based on the comparison between non-problem gamblers, problem gamblers not seeking treatment and problem gamblers seeking treatment.

Results

Factor Analysis

Results of the CFA performed on the study 2 sample indicated that most fit indices were good, which shows that the SCALE multidimensional model of the GABS did fit the data effectively (see Table 1). Similarly to study 1's results, the χ^2 for each tested model presented a significant value, however the goodness of fit of the GABS-23 was considered acceptable.

Psychometric Properties of the GABS-23

Internal Consistency and Scalability of the GABS-23 Internal consistency and scalability computed on the study 2 sample were compared with those computed on the study 1 sample (see Table 2). Cronbach's α and Loevinger's H coefficients showed the same pattern of results in the both samples, i.e. acceptable internal consistencies ($\alpha \geq 0.70$ or near) and correct scalabilities ($H > 0.3$) for each dimension. However, α coefficients were lower than in study 1 for "attitudes", "luck" and "strategies" dimensions, even if the population was thought to be more suitable to explore the GABS validity. Nevertheless, the α coefficient of the "strategies" dimension is not so different from study 1.

Known-Groups Validity of the GABS-23 In the same way as in study 1, overall and dimensional scores of the GABS-23 were found to discriminate significantly between non-problem gamblers and problem gamblers not seeking treatment. As in study 1, only "chasing" and "emotions" scores were able to discriminate between problem gamblers not seeking treatment and problem gamblers seeking treatment.

Construct Validity of the GABS-23 Results of the multitrait analysis allowed us to detect only two items (18 and 26) that were more correlated with the score of "chasing" dimension ($R = 0.447$ and $R = 0.522$, respectively) than the score of their own dimension "emotions" ($R = 0.372$ and $R = 0.443$ respectively). Nevertheless, the correlation coefficients were not so different in the two cases.

Multitrait-Multimethod Convergent and Divergent Validities of the GABS-23 Results for the convergent and divergent validities showed the same pattern of results as in study 1, i.e. a positive correlation between cognitive distortions and gambling problems, and two distinct patterns of correlation with SOGS score: a high correlation with "chasing" and "emotions" dimensions and a low correlation with "strategies", "luck" and "attitudes" dimensions. Moreover, the correlation coefficients between GABS-23 overall and subscale scores were higher than in study 1, that is from 0.67 to 0.81, confirming the positive links between the five dimensions.

Severity of Gambling Problems

As expected, problem gamblers seeking treatment displayed a significantly higher number of positive DSM-IV criteria ($M = 6.48$, $SD = 1.89$) than the problem gamblers not seeking treatment ($M = 5.24$, SD = 1.88) ($F = -7.40$, $p < 0.0001$), indicating a higher severity of gambling problems in the treatment seeking group.

Gender Differences

In the same way as in study 1, results of the gender comparisons showed that females scored significantly lower on the overall score of the GABS-23 ($F = 5.82$, $p = 0.016$). On the other hand, contrary to study 1, both "luck" and "emotions" dimensions showed no statistical differences between males and females (respectively, $F = 1.36$, $p = 0.243$ and $F = 1.60$, $p = 0.206$), whereas females scored significantly lower on each of the other dimensions (each of the p value were under 0.02). The observed scores for females, although non significantly, were lower for the "emotions" dimension (in the same way of other dimensions), and higher for the "luck" dimension (reversed to the other dimensions).

Discussion of Study 2

The aim of study 2 was to ensure the reliability and stability of the new structure of the GABS proposed in study 1. In particular, study 2 allowed us to re-test the revised structure of the GABS in an independent and more suitable sample, and with a more accurate measure of problem gambling.

The only divergence between study 1 and study 2 was about gender differences. In study 2, females and males showed no statistical differences for the "emotions" dimension, which is due to an increased score in females in study 2 compared to study 1. This is not surprising in this sample composed mainly of problem gamblers, because problem female gamblers are known to gamble for escapement (escaping from day-life problems and relieving a dysphoric mood) (Blanco et al. 2006; Grant and Kim 2002; Potenza et al. 2006).

The validity and stability of the new GABS-23 has been confirmed in study 2.

General Discussion

The psychometric properties and the validity of the five-factor SCALE structure of the GABS-23 have been twice confirmed, both in a heterogeneous sample (a mixture of students and problem gamblers) and in a more homogeneous sample of gamblers. The GABS-23 was found to discriminate non-problem from problem gamblers as efficiently as the original GABS. Moreover, the French version of the GABS has been validated for a use in French-speaking countries.

Initially, we wanted to create a model based on distinctions between gambling-related beliefs ("strategies" and "luck" dimensions), behaviors ("chasing" and "attitudes" dimensions) and emotions. However, another model seemed to emerge, grouping dimensions into three constituent categories: "attitudes" and "strategies" dimensions as a first component (correlation coefficient between those two dimensions: 0.57), the "luck" dimension as a second component (correlation coefficients less to 0.40 with any other dimension), and "emotions" and "chasing" dimensions as a third component (correlation coefficient between those two dimensions: 0.75). Upon secondary analysis, it appears that the locus of control (LOC) theory might offer a better explanation of this re-alignment of dimensions. LOC is a psychological construct of personality with reference to the perception of the extent to which individuals can control events (Rotter 1966). Internal LOC is associated with an individual's own control over events, and external LOC with attributing events to external sources. In the case of gambling, the notion of LOC refers to the "attributional biases" described by Toneatto (1999): external LOC refers to the attribution of losses to bad luck, and internal LOC to the attribution of wins to one's own personal behavior and/or skill.

Based on the hypothesis of a link with this theory of LOC, the "attitudes" and "strategies" dimensions seem to be linked under the internal LOC concept, while the dimension "luck" seems to have a stronger link to external LOC. This could explain why the "luck" dimension did not have the same pattern of results as the "attitudes" and "strategies" dimensions.

The last two dimensions ("emotions" and "chasing") were the only ones that could distinguish between problem gamblers not seeking treatment and problem gamblers seeking treatment. Two hypotheses may be invoked to explain this particularity. The first suggests that those two dimensions are equivalent to two DSM criteria for PG, so problem gamblers seeking treatment would tend to have higher scores on these dimensions for obvious reasons. The "emotions" dimension would reflect the fifth DSM criteria ("*gambles as a way of escaping from problems or of relieving a dysphoric mood …*"), when the "chasing" dimension would reflect the sixth criteria ("*after losing money gambling, often returns another day to get even ("chasing" one's losses)*") (APA 2000). The second hypothesis is based on the reinforcement models of PG (Abrams and Kushner 2004). If the gambling behavior is learned based on both positive and negative reinforcements, it seems that the positive reinforcements (winnings, excitation to play …) gradually disappear giving way to negative reinforcements (chasing losses, escaping from problems …) when gambling problems emerge. By this logic, both the within session chasing behavior and unpleasant states of arousal act as negative reinforcements that maintain the excessive gambling behavior. A high level of those two negative reinforcements would then be an indicator of greater severity of the gambling problems, especially at a stage of treatment (when problem gamblers showed a higher number of DSM-IV criteria).

This set-up where, on the one hand, three dimensions could relate to the concept of LOC, and on the other hand, two dimensions seem to refer to gambling problems at a stage of treatment, may explain why dimensions probably referring to the concept of LOC were so poorly correlated with gambling problems. It's also an explanation of the redundancy of some items in two dimensions in the multitrait analysis. In study 1, item 14 is redundant with the "emotions" and "chasing" dimensions, which are both associated with gambling problems, and item 28 is redundant with "strategies" and "attitudes" dimensions, which are both associated with internal LOC. In study 2, item 18 and 26 are redundant with the "emotions" and "chasing" dimensions, like item 14 in study 1. This new model may also explain why some α coefficients (for "attitudes", "strategies" and "luck" dimensions) decreased in study 2 compared to study 1. Indeed, "strategies" and "attitudes" dimensions seem to be more related to the LOC concept than to gambling problems, which may explain why those two dimensions are less consistent in study 2, where the sample is predominantly composed of problem gamblers. This hypothesis is supported by the fact that α coefficients in the non-problem gamblers group alone are more satisfactory and closer to study 1 ($\alpha = 0.70$ for « attitudes » and $\alpha = 0.68$ for « strategies »—results not shown). For the "luck" dimension, at the opposite, the α coefficient was better in the problem gamblers seeking treatment group ($\alpha = 0.73$), even if this dimension is also supposed to be more related to the LOC concept than to gambling problems. This seems to be due to a problem with item 8, which has a formulation without reference to gambling ("*some people are unlucky*"). Moreover, this item is formulated as a "general truth" rather than as an "attributing thought", which would be more suitable to the LOC concept.

As in Breen and Zuckerman's results (1999), females scored significantly lower than males on both the overall GABS-23 score and on the five dimensions, except for "luck" dimension where there is no statistical difference between females and males (with an observed score higher for females, even though non significantly, for both study 1 and study 2). Similar results were found using another cognitive distortions assessment tool (Raylu and

Oei 2004). When one applies the concept of LOC to explain "attitudes", "strategies" and "luck" dimensions, it becomes easier to understand why females, for whom external LOC is known to be influential (Deaux and Emswiller 1974), showed increased scores to the "luck" dimension, explaining the reversed tendency for this dimension.

Further studies need to be realized to clarify the pertinence of this model, especially regarding to gambling trajectory, gambling behaviors, some personality measures (LOC and others), emotional regulation or psychiatric comorbidities for example … We are currently conducting a study to verify the links between the multidimensional model of the GABS and the LOC theory with grounded data.

Conclusion

The GABS-23 is a useful assessment tool for investigating the strength of irrational beliefs and attitudes among pathological and social gamblers. It can be used efficiently in research studies about gambling, and in clinical practice, in order to assess the efficacy of CBT, for example. The GABS-23 has good psychometric properties and discriminates non-problem from problem gamblers as efficiently as the original GABS. Moreover, it presents the advantage of being shorter than the original GABS, and of screening irrational beliefs and attitudes about gambling in a multidimensional way, making it possible to explore distinct facets of gambling-related cognitions. Further description of the specificities of the five facets of the GABS-23 is needed, particularly with regard to the LOC theory.

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Conflict of interest The Reference Centre for Excessive Gambling has received funding support directly from University Hospital of Nantes and from two gambling industry operators ("*Française Des Jeux*" and "*Pari Mutuel Urbain*"). Scientific independence towards gambling industry operators is warranted.

Appendix 1: French Version of the Gambling Attitudes and Beliefs Survey (GABS)

Pour les questions 1 à 35, merci de noircir le cercle correspondant à la proposition qui décrit le mieux ce que vous ressentez lorsque vous jouez. Par jeu, on entend les jeux de hasard et d'argent, tels que les jeux de cartes, de dés, les machines à sous, ou tous les types de jeux pour lesquels vous misez de l'argent ou faites des paris.

Vous ne devez choisir qu'une seule réponse et vous avez le choix entre les propositions suivantes:

- complètement d'accord (1)
- plutôt d'accord (2)
- plutôt pas d'accord (3)
- pas du tout d'accord (4)

	(1)	(2)	(3)	(4)
1. Jouer me donne le sentiment d'être vraiment vivant.	❍	❍	❍	❍
2. Si je n'ai remporté aucun de mes paris pendant un certain temps, c'est que je vais probablement toucher le gros lot bientôt.	❍	❍	❍	❍
3. Il n'y a pas moyen de savoir si je vais avoir de la chance ou de la malchance.	❍	❍	❍	❍
4. Je respecte quelqu'un qui fait de très gros paris, et qui reste tranquille et calme.	❍	❍	❍	❍
5. Parfois, je perds la notion du temps quand je suis en train de jouer.	❍	❍	❍	❍
6. Je sais lorsque je suis sur une bonne lancée.	❍	❍	❍	❍
7. Lorsque je joue, il est important que j'agisse comme si j'étais calme, même si je ne le suis pas.	❍	❍	❍	❍
8. Certaines personnes sont malchanceuses.	❍	❍	❍	❍
9. Je me sens super-bien lorsque je remporte un pari.	❍	❍	❍	❍
10. Il est important que je me sente sûr(e) de moi lorsque je joue.	❍	❍	❍	❍
11. Jouer est ennuyeux.	❍	❍	❍	❍
12. Il est des personnes dont la présence porte chance lorsque je joue.	❍	❍	❍	❍
13. Les gens qui jouent sont plus audacieux et aventuriers que ceux qui ne jouent jamais.	❍	❍	❍	❍
14. Je n'aime pas abandonner lorsque je perds.	❍	❍	❍	❍
15. Il est nécessaire d'avoir une certaine adresse pour gagner au jeu de dés.	❍	❍	❍	❍
16. Parfois, je sais que je vais avoir de la chance.	❍	❍	❍	❍
17. Les gens qui parient gros peuvent être très attirants.	❍	❍	❍	❍
18. Si vous n'avez jamais connu l'excitation de faire un gros pari, vous n'avez jamais réellement vécu.	❍	❍	❍	❍
19. Peu importe le type de jeu, il existe des stratégies de paris qui peuvent vous aider à gagner.	❍	❍	❍	❍
20. J'ai eu un porte-bonheur sur moi lorsque j'ai joué.	❍	❍	❍	❍
21. Si je perds au jeu, il est important que j'agisse avec calme.	❍	❍	❍	❍
22. Jouer ne m'excite pas beaucoup en général.	❍	❍	❍	❍
23. La roulette demande plus de compétences que la loterie.	❍	❍	❍	❍
24. Les casinos sont des endroits excitants et envoûtants.	❍	❍	❍	❍
25. Si j'ai été chanceux dernièrement, je devrais forcer la mise.	❍	❍	❍	❍
26. Je me sens en colère lorsque je perds au jeu.	❍	❍	❍	❍
27. Si je me sentais déprimé, jouer me ferait probablement remonter la pente.	❍	❍	❍	❍
28. Je dois bien être familier avec un jeu si je veux gagner.	❍	❍	❍	❍
29. Certaines personnes peuvent porter la poisse aux autres.	❍	❍	❍	❍
30. Il est important de me comporter d'une certaine façon lorsque je gagne.	❍	❍	❍	❍
31. Si je perds, il est important que je m'accroche jusqu'à ce que je me refasse.	❍	❍	❍	❍
32. Pour jouer avec succès, je dois être capable d'identifier des séries.	❍	❍	❍	❍
33. Si j'ai perdu dernièrement, ma chance va forcément tourner.	❍	❍	❍	❍
34. C'est important d'être un gagnant élégant.	❍	❍	❍	❍
35. J'aime jouer parce que ça m'aide à oublier mes problèmes de la vie quotidienne.	❍	❍	❍	❍

items supprimés (*pour la version GABS-23*)

Appendix 2: English-Version and Scoring of the GABS-23 [for the English Version of the Full GABS and Its Original Scoring, See Breen and Zuckerman Paper (Breen and Zuckerman 1999)]

For questions 1 thru 23, please blacken the circle which correspond to the proposition that best describes the way you feel when you're gambling. You must choose only one answer by item within the followed propositions:

- strongly agree
- agree
- disagree
- strongly disagree

	strongly agree	agree	disagree	strongly disagree
1. Gambling makes me feel really alive.	❍	❍	❍	❍
2. If I have not won any of my bets for a while, I am probably due for a big win.	❍	❍	❍	❍
7. When I gamble it is important to act as if I am calm, even if I am not.	❍	❍	❍	❍
8. Some people are unlucky.	❍	❍	❍	❍
10. It is important to feel confident when I'm gambling.	❍	❍	❍	❍
12. Some people are lucky to have around when I'm gambling.	❍	❍	❍	❍
14. I don't like to quit when I'm losing.	❍	❍	❍	❍
18. If you have never experienced the excitement of making a big bet, you have never really lived.	❍	❍	❍	❍
19. No matter what the game is, there are betting strategies that can help you to win.	❍	❍	❍	❍
20. I have carried a lucky charm when I gambled.	❍	❍	❍	❍
21. If I lose at gambling, it is important to act calm.	❍	❍	❍	❍
23. Roulette takes more skill than playing the lottery.	❍	❍	❍	❍
25. If I have been lucky lately, I should press my bets.	❍	❍	❍	❍
26. I feel angry when I lose at gambling.	❍	❍	❍	❍
27. If I were feeling down, gambling would probably pick me up.	❍	❍	❍	❍
28. I must be familiar with a gambling game if I am going to win.	❍	❍	❍	❍
29. Some people can bring bad luck to other people.	❍	❍	❍	❍
30. It's important to act a certain way when I win.	❍	❍	❍	❍
31. If I lose, it is important to stick with it until I get even.	❍	❍	❍	❍
32. To be successful gambling, I must be able to identify streaks.	❍	❍	❍	❍
33. If I have lost my bets recently, my luck is bound to change.	❍	❍	❍	❍
34. It's important to be a gracious winner.	❍	❍	❍	❍
35. I like gambling because it helps me to forget my everyday problems.	❍	❍	❍	❍

Scoring of the GABS-23:

All items are coded as follow: strongly agree = 3, agree = 2, disagree = 1 and strongly disagree = 0.

To obtain raw subscale scores, add scores of items that composed each subscale:

- GABS-S (*strategies*): 19, 23, 28 and 32
- GABS-L (*luck*): 8, 12, 20 and 29
- GABS-A (*attitudes*): 7, 10, 21, 30 and 34
- GABS-C (*chasing*): 2, 14, 25, 31 and 33
- GABS-E (*emotions*): 1, 18, 26, 27 and 35

We recommend to use standardized scores. To obtain the standardized score of a subscale, divide the raw subscale score by three times the number of items of the subscale, and multiply the result by 100. The overall standardized score can then be computed as the unweighted mean of the 5 scores.

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